

## **I. Overview of the Water Quality Assessment Process**

### **C. Water Quality Policy 1-11 (revised September, 2002)**

#### **i. Additional Clarification of the Assessment Criteria for Temperature and Dissolved Oxygen**

##### Background

The decision to establish separate listing criteria for these parameters came about from Ecology's study of the limitations of the 1998 listing methodology to indicate true impairment of a water body. Ecology studied the binomial distribution process and determined that it was a better method for determining impairment based a statistical probability of the water body being impaired, rather than basing it on a percentage of samples that exceeded the standard. Ecology's goal in trying to determine true impairment of a water body was to avoid, to the extent possible, the inclusion of "false positive" listings. That is, listing a water body as impaired when it is not in fact violating the standard. False positive listings cause Ecology and others to waste efforts on water bodies that are actually meeting standards, which in turn takes focus away from addressing water bodies that are truly in violation of the standards.

Initially Ecology intended to include both temperature and DO parameters in the group of conventional parameters that would be assessed based on the binomial distribution. (For more information on this binomial distribution method, refer to the discussion paper titled "Justification for using the Binomial Distribution Approach for 303(d) Listing in Washington State.")

However, upon further discussion with other Water Quality Program and Environmental Assessment Program staff, several questions were raised about the seasonal nature of temperature and DO exceedances, and it was agreed that these parameters were not well suited for using the binomial distribution from year-round samples to determine impairment. With this agreement, Ecology staff revisited assessment criteria for these two parameters.

The parameters of temperature and dissolved oxygen differ from the other conventional pollutants because they are seasonally variable and because they always exist in the water and become pollutants only when there is too much or too little of them. The water quality standards are designed to address the highest temperatures of the year and the lowest dissolved oxygen levels of the year, which both generally occur during summer months, or sometimes fall months for dissolved oxygen. Therefore, the assessment decision is based on the highest and lowest measurements of these pollutants, respectively, not on year-round measurements.

It was also noted during technical discussions that using single exceedances of temperature and DO to determine impairment are problematic because of the natural variability that can occur with these parameters on a given day and season. To be able to determine impairment based on

### Department of Ecology

continuous monitoring, averages provide a much greater assurance that an actual impairment exists. For this reason, Ecology proposed in the draft Policy 1-11 for 2002 to use the “7-Day Average of the Daily Maximum” or “7-DADMax” as the standard for measuring temperature and the “7-Day Average of the Daily Minimum” or “7-DADMin” for DO impairments. The 7-DADMax (or Min) is the arithmetic average of seven consecutive measures of daily maximums or minimums. The 7-DADMax (or Min) for any individual day is calculated by averaging that day’s daily maximum or minimum level with the daily maximum or minimum levels of the three days prior and the three days after that date. This standard was chosen primarily because:

- 1) Sublethal chronic biologic reactions generally take more than a week’s exposure to become meaningful;
- 2) Small daily maximum or minimum fluctuations beyond some “healthy” target level will not be biologically meaningful but if a single daily maximum metric were chosen and then not attained, such fluctuations would have regulatory repercussions; and
- 3) It is not as defensible to use weekly averages of the daily average levels because fluctuations about the mean temperature or DO can be highly variable and extreme fluctuations will erase or diminish the benefits of otherwise healthy average levels.

#### Decisions on Policy 1-11 for Temperature and Dissolved Oxygen

The final policy decision for temperature and DO criteria assessments was to have assessment criteria for both continuous monitoring data or single “grab sample” data, depending on what sampling regime was used. Because of the problems noted above with using single exceedances as a basis for determining impairment, it was agreed that single exceedances would need multiple years of data exceedances to place the water body on the 303(d) list as impaired.

#### **Comparison Of Temperature/Dissolved Oxygen Policies**

<b>Version of policy</b>	<b>Criteria for listing</b>	<b>Natural conditions</b>
1998 and earlier policy	10% of instantaneous grab samples violate WQS, minimum of two samples in one or more years	Do not list if natural
2002/2004 policy	1 seven-day average of the daily maximum or minimum in any one year – OR – At least one instantaneous grab sample in 3 different years	Do not list if natural; emphasize that we will consider natural conditions relating to temperature before listing

The 1998 policy required ten percent of the samples to be exceedances. When applied to annual sampling, this meant two samples in one year that violated the standard would result in declaring

## **Department of Ecology**

the water impaired for purposes of the 303(d) list. Many segments were listed for as little as two or three high temperatures readings, typically two hot monthly samples out of a year or a few hot days out of a summer.

### **Notes on Seven Day Averages vs. Single Grab Sample Data**

One seven-day average exceedance would require high temperatures (or low DO) for a total of at least seven days, though not each of those days would need to be above the standard, so long as the average was above the standard. Seven days is slightly under 10% of the “hot season”.

The policy requiring that the single grab sample violations occur in multiple years was intended to provide a more reliable amount of data, and to ensure the validity of the exceedance as an impairment. Monthly samples taken in the course of the same year might merely reflect an extremely hot year. In effect, additional years’ worth of samples act as a replicate set, testing the validity of the exceedances measured in the first year.

Even when a sample result falls within the confidence limits of the sampling and analytical procedures, a single measurement of oxygen or temperature does not indicate that a water body is impaired. The purpose of the 303(d) list is to identify waters where persistent problems exist, with the expectation that a Total Maximum Daily Load (TMDL) must be done to bring the water into compliance with the standards. Waters that have small and very infrequent excursions (especially parameters that naturally exceed standards at certain times of the year) would not be considered persistently impaired and are not intended to be a candidate for the 303(d) List that in turn triggers a TMDL.

Additionally, since concentrations of dissolved oxygen and water temperatures can vary substantially from day to day, a single day's excursion may be within the recurrence intervals allowed for the individual criteria (e.g., toxics criteria may be exceeded at intervals greater than once every three years on average, and oxygen and temperature criteria are set to be met only 9 of every 10 years on average). It is highly probable that listing waters based on single daily samples from one year would queue up waters for TMDL work that are actually meeting the criteria. By using weekly average (minimum or maximum values depending on the parameter) or by using single sample excursions from multiple years, we better ensure that the water body needs and will benefit from a TMDL. If a criteria is exceeded as a weekly average it shows the overall condition is exceeding the criteria and it makes it unlikely that we would queue up a TMDL in response to a rare event. The use of an average also removes much of the concern over the possibility that a single sample was erroneous; read or recorded incorrectly. Thus the use of average conditions improves our credibility when dealing with communities and the public, and ensures that our resources are going towards correcting problems that actually exist.

The monitoring we perform as part of TMDL development is very rigorous. In the case of temperature, it is almost always continuous monitoring. For dissolved oxygen, we use a combination of continuous monitoring and collecting grab samples. In addition, we use modeling to predict potential exceedances. This rigorous approach gives us confidence that the single year of data we collect as part of TMDL production accurately portrays the condition of the water body.

## Department of Ecology

### Results from Assessment of Temperature Data

Results from assessment of temperature data for the past 10 years, using Policy 1-11 criteria, resulted in a total of 842 listings on the draft 2002/2004 Assessment for Category 5. This compares with 439 listings on the 1998 303(d) List. Clearly, the revised policy for listing did not cause a reduction of temperature listings, as results indicate an almost doubling of temperature listings from the 1998 list.

Of the total number of temperature listings on the proposed 2002/2004 Category 5, the breakout between waters listed in 1998 and new waterbody listings is as follows:

Listed for temperature on the 1998 303(d) List:	258
<u>New waterbody listings (not on the 1998 list)</u>	<u>584</u>
TOTAL for 2002/2004	842

The 1998 303(d) List had a total of 439 waters listed for temperature. Of that total, the 2002/2004 assessment placed temperature listings for water in the following categories:

Category 1 (meets tested standards)	13
Category 2 (waters of concern)	120
Category 4A (Has a TMDL)	42
Category 4B (Pollution Control Plan)	6
<u>Category 5 (303(d) List)</u>	<u>258</u>
TOTAL	439

Waters that moved to Category 1 are from natural condition determinations, or from more recent data showing that the water body was meeting standards.

Waters that moved to Category 2 resulted from assessment of the data using Policy 1-11, either because of quality assurance questions or from single grab sample exceedances of data that did not meet the 3 years of data required by Policy 1-11.

Waters that moved to Category 4A or 4B have a TMDL or pollution control plan in place to reduce impacts of temperature and bring the water back into compliance with standards or the natural condition of the water.

Waters that stayed on Category 5 resulted from assessment of data using Policy 1-11, either because continuous monitoring was available or because there was 3 years of data from single grab samples showing exceedances. It is noteworthy that the doubling of temperature listings for the 2002/2004 list indicates that a preponderance of temperature monitoring since 1998 has been through the use of continuous monitoring techniques. This method of monitoring gives a much better indication that the water is exceeding standards, and is the preferred "state of the art" method for sampling the effects of temperature. Evidenced by the doubling of listings for the 2002/2004 list, we are confident that Policy 1-11 has not established assessment criteria for temperature that is causing a significant level of false negative listings to occur (that is, not listing a water body that is in fact impaired).

## Department of Ecology

### Results from Assessment of Dissolved Oxygen Data

Before providing results from the assessment of data for the 2002/2004 listing, Ecology first must note that the initial assessment of dissolved oxygen based on Policy 1-11, especially the requirement for exceedances in 3 different years, produced results that called into question the possibility that we were taking waters off the 303(d) List that had a stronger possibility of being impaired. This problem was noted by the Environmental Assessment Program staff, who indicated that when they go in to do monitoring for dissolved oxygen, they typically only monitor for two years before moving to another geographic area. This was further exacerbated by the much lower proportion of continuous monitoring performed for dissolved oxygen as compared to temperature.

Because of this, Ecology re-examined the listing policy for dissolved oxygen in consultation with technical staff. Policy 1-11 allows deviation from the criteria outlined in the policy on page 30, as follows:

#### ***Other Situations***

*Ecology reserves the right to make assessment decisions on matters not addressed by this policy or in a manner not in complete accordance with the details of this policy as needed to address unforeseen situations. The ultimate judgment in assessment decisions will be based on whether, based on the available data, characteristic uses in a waterbody segment are supported or impaired as determined in accordance with the water quality standards and the relevant state and federal laws and regulations.*

Based on the re-examination and the above allowance, Ecology internally revised the dissolved oxygen criteria to require only 2 years of exceedances to be placed on the 303(d) list. Remarks are included for each affected listing to say:

*During the assessment of data it was determined that WQ Policy 1-11 (updated 9/03) was overly restrictive for the number of years of data excursions needed to list for D.O. impairments. Based on a review of monitoring studies for DO statewide, it was determined that multiple (3 or more) excursions for at least two years of monitoring should be used as an alternative indicator that a water body continues to be impaired. (Braley, ECY/WQP, 2003)*

Results from assessment of dissolved oxygen data for the past 10 years, using the revised Policy 1-11 criteria, resulted in a total of 369 listings on the draft 2002/2004 Assessment for Category 5. This compares with 216 listings on the 1998 303(d) List. Clearly, the revised policy for listing did not cause an overall reduction of dissolved oxygen listings, as results indicate a 58% increase in dissolved oxygen listings from the 1998 list.

Of the total number of dissolved oxygen listings on the proposed 2002/2004 Category 5, the breakout between waters listed in 1998 and new waterbody listings is as follows:

Listed for dissolved oxygen on the 1998 303(d) List:	106
<u>New waterbody listings (not on the 1998 list)</u>	<u>263</u>
TOTAL for 2002/2004	369

## Department of Ecology

The 1998 303(d) List had a total of 216 waters listed for dissolved oxygen. Of that total, the 2002/2004 assessment placed dissolved oxygen listings for water in the following categories:

Category 1 (meets tested standards)	2
Category 2 (waters of concern)	87
Category 4A (Has a TMDL)	21
Category 4B (Pollution Control Plan)	0
<u>Category 5 (303(d) List)</u>	<u>106</u>
TOTAL	216

Waters that moved to Category 1 are from more recent data showing that the water body was meeting standards.

Waters that moved to Category 2 resulted from assessment of the data using the internally revised Policy 1-11, either because of quality assurance questions or from single grab sample exceedances of data that did not meet the 2 years of data requirement.

Waters that moved to Category 4A have a TMDL in place to reduce impacts of dissolved oxygen depletion and bring the water back into compliance with standards or the natural condition of the water.

Waters that stayed on Category 5 resulted from assessment of data using the internally revised Policy 1-11, either because continuous monitoring was available or because there was at least 2 years of data from single grab samples showing exceedances.

### Ecology Support for the three-year Limit for Single Grab sample exceedances

#### **Temperature**

Ecology believes that continuous temperature (7DADMax) monitoring represents the best method for indicating impairments from temperature. Thus, we encourage continuous monitoring sampling and are seeing evidence that a high percentage of more recent data is coming in as continuous. Recognizing that single grab samples give a much higher probability that “false positive” listings will occur, Ecology believes that requiring three years of data for single exceedances is reasonable. In effect, most entities monitoring for temperature today should be using continuous monitoring as the most reliable and “state of the art” method of indicating temperature problems. In fact, this is emphasized in EPA’s Regional Temperature Guidance for Region 10 States (see page 19 of the regional guidance)

Waters that have moved from the 1998 303(d) list to Category 2 as a result of the assessment criteria will be highlighted for further monitoring to determine the status of temperature impairment. This will be done as part of the regional TMDL prioritization and will also be in consultation with Environmental Assessment Program staff as they establish monitoring priorities. The Monitoring Strategy developed for Washington notes the use of Category 2

## **Department of Ecology**

waters as a means for determining monitoring priorities.

### **Dissolved Oxygen**

As described above, Ecology re-examined the listing criteria for dissolved oxygen and determined that two years of exceedances were more appropriate than three years for determining the probability that the water body is impaired. While Ecology believes that continuous monitoring is the better sampling methodology for determining actual dissolved oxygen problems, we recognize that the technology is not as advanced as for temperature, although we believe in time continuous monitoring for dissolved oxygen will become more prevalent and reliable as a sampling regime.

Waters that have moved from the 1998 303(d) list to Category 2 as a result of the assessment criteria will be highlighted for further monitoring to determine the status of dissolved oxygen impairment. This will be done as part of the regional TMDL prioritization and will also be in consultation with Environmental Assessment Program staff as they establish monitoring priorities. The Monitoring Strategy developed for Washington notes the use of Category 2 waters as a means for determining monitoring priorities.

